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ABSTRACT

The results of a Wellington (New Zealand) project to develop science instruction materials for teachers with non-native learners of English are presented. The first section describes the project, which involved the collaboration of science teachers and English-as-a-Second-Language (ESL) specialists, offers general guidelines for language learning in science classes, presents panel responses to science and ESL teachers' questions, and includes a 36-item bibliography on English throughout the curriculum and science and ESL teaching materials. The three subsequent sections are sample instructional units on the kinesthetic senses, matter, and electricity. The unit on kinesthetic senses consists of a sequence of classroom activities, each annotated with advice and information related to ESL learners. It contains an original worksheet, a vocabulary list and notes, an annotated worksheet, and notes to the teacher. The unit on matter includes three pre-tests, instructional outlines for introducing and applying new information, notes on evaluation, guidelines for working with ESL science learners, and teacher notes on pre-testing. The electricity unit contains a series of sample visual aids, annotated for teacher use, on simple circuits, symbols, and electron flow. The last two pages suggest cultural, linguistic, and cognitive aspects of classroom instruction for the teacher to consider. (MSE)

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**Booklet 1**

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# SCIENCE AND SECOND LANGUAGE LEARNERS

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**Wellington 1986**

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# SCIENCE AND SECOND LANGUAGE LEARNERS

## What we did

A group of ESL specialists and science teachers met together with the aim of producing illustrated guidelines to help science teachers who have ESL learners in their classrooms.

Starting with secondary science topics and, in some cases, existing worksheets, we produced annotated materials to show how ELS learners' needs can be taken into account in normal science classes. The suggestions made are summarised in a set of ganeralised language learning guidelines.

## Objectives

As we worked together, we had in mind the integration of science and communication objectives. At the most general level these were as follows:

### Logical thinking

- To predict what is likely to happen.
- To describe what actually happened.
- To compare the results with the prediction.
- To attempt to work out the reasons for the difference.
- To draw conclusions.

### Practical skills

- To record results in sequence.
- To graph results.
- To read and interpret results.
- To interpret a diagram.
- To diagram the result of an experiment.

### Language skills

Clearly the above objectives all involve language use, but other language skills such as the following can also be specified:

- To follow spoken and written instructions.
- To understand what the teacher says.
- To read textbooks and other written material.
- To discuss all activities.
- To write an account of the experiments done.
- To learn the vocabulary of the lesson.

## What we produced

Introduction with general guidelines for language learning in science classes, and bibliography

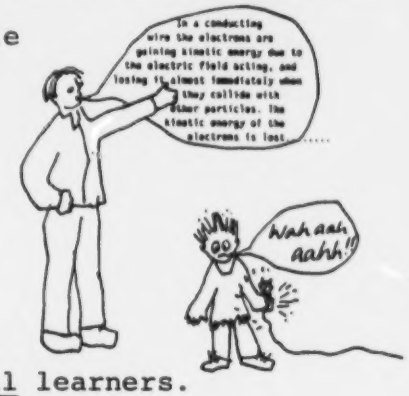
Three sets of annotated teaching material. Each set has teachers' notes making points which arose out of that unit.

| | |
|---|---|
| - **Matter** | The teachers' notes include suggestions for pre-testing for a science unit. |
| - **Electricity** | The notes make suggestions in the areas of culture, language and learning. |
| - **Kinaesthetic Senses** | The notes deal with adapting worksheets and using them in class. |

## GENERAL GUIDELINES FOR LANGUAGE LEARNING IN SCIENCE CLASSES

These guidelines are a summary of the most important points which arose when we were writing materials to suit ESL learners; needs.

**GG1** * Make input comprehensible to <u>your</u> learners. Use alternative learning resource:


In a conducting wire the electrons are gaining kinetic energy due to the electric field acting, and losing it almost immediately when they collide with other particles. The kinetic energy of the electrons is lost.....
Wah aah aahh!!

**GG2** * Use the background of <u>all</u> learners. Background knowledge and previous experience are major factors in understanding new input. Take into account

- cultural background
- previous experiences
- language background
- learning styles

**GG3** * Set tasks which require the use of language to achieve a definite outcome. Some of the best language learning occurs when people are totally involved in getting a job done and are using language to do it. The process and final outcome both give feedback on how adequate the learners' language is for the task.

**GG4** * Learners should have a chance to discuss concepts in their first language with other children or adults. This discussion in language with which the learners feel comfortable enables them to understand the concepts thoroughly. This in turn gives them the background knowledge required for new content and language learning.

GG5 * Encourage wide reading and provide lists of important words to learn. Vocabulary expansion is probably the single most important language learning task. Extensive reading is probably the best way to achieve this, but deliberate instruction and conscious word learning can also play an important part.

GG6 * Give ESL learners some language focus and support, especially in their homework. They will acquire a lot of English 'on the job' but if they are to catch up to the native speakers of English they need to spend extra time productively focusing on important aspects of language.

GG7 * Provide work at different levels of difficulty on the same topic. Vary language, task and conception difficulty.

## NOTES FROM A PANEL DISCUSSION

A panel discussion suggested answers to questions put forward by teachers of science and teachers of English to second language learners. The responses recorded here were spontaneous answers. rather than the result of research and reading.

1 Can you suggest some cultural material that could be included in chemistry, physics and biology lessons.

a Real life material that can draw on preferences in food and familiar plants. eg. spices, dyes.

b Reference to traditional healing medicines.

c Pictures can show a greater variety of people and lifestyles.

d Rock formations in the Pacific eg. atolls.

e Geological features from other parts of the world. eg. the effects of weathering on monuments such as Angkor Wat.

f Scientific knowledge passed down through Maori oral history.

g Parallel versions in mythology and legend to explain natural phenomena.

h Experiences of some refugee children in surviving in the outdoors for long periods of time.

2 What expectations do students from different ethnic backgrounds have of science?

a First generation immigrants often have high expectations that science will open the door to higher learning.

b Some may experience conflicts with apparent discrepancies between previous mythological and/or religious teaching and the scientific explanations offered in schools.

3 What difficulties have teachers noticed in science classes?

a Some aspects of human biology are embarrassing to children from traditions where parts of the body and bodily functions are not talked about.

b In physical education and sports lessons girls may find it embarrassing to be asked to appear in shorts.

4 What should teachers know about culturally preferred styles of working?

a There may be a difference between traditional ways of working and the actual school experiences children have had. eg. group learning versus sitting in rows in class.

b 'Freer' attitudes to discipline in New Zealand schools may lead to confusion in students' minds as to where the boundaries lie.

c The New Zealand encouragement of questioning by students may conflict with the viewpoint of some cultures that adults, and teachers in particular, are authoritarian figures who have all the answers.

d Some cultures allow for longer spaces between the parts of a conversation than is allowed for in the quick to and fro of questions and answers in New Zealand classrooms.

(Note that a number of publications deal with issues related to crosscultural understanding.)

5 Should schools offer sixth form certificate subjects specifically to cater for particular cultural groups?

The feeling was that in time this will certainly happen, and that it is only as subjects receive official status that they are taken seriously.

SELECTED BIBLIOGRAPHY

1 English through the Curriculum

Barnes, D. 1973, Language in the Classroom, Open University Press.

Barnes, D. 1976, From Communication to Curriculum, Penguin.

Barnes, D. 1977, Talking and writing in Science lessons Cambridge Journal of Education 7, 3: 138-147

Barnes, D., J. Britton and H. Rosen, 1969, Language, the Learner and the School, Penguin.

Carrell, Patricia L, 1983, Three components of background knowledge in reading comprehension Language Learning 33, 2: 183-207

Coelho, Elizabeth, 1982, Language across the curriculum TESL Talk 13, 3: 56-70

Conroy, John and Muriel Healey, 1982, Some issues regarding the place of language in learning mathematics Working Papers in Language and Linguistics 14: 43-67

Elley, Warwick B. and Francis Mangubhai, 1981, The long-term effects of a book flood on children's language growth Directions 7: 15-24

Hutchinson, Tom and Alan Waters, 1982, Creativity in ESP materials or "Hello! I'm a blood cell" Lancaster Practical Papers in English Language Education 5: 100-122

Hutchinson, Tom and Alan Waters, 1984, How communicative is ESP? ELT Journal 38, 2: 108-113

Johns, Tim and Florence Davies, 1983, Text as a vehicle for information: the classroom use of written texts in teaching reading in a foreign language Reading in a Foreign Language 1, 1: 1-19

Kraus-Srebric, Eva, L. Brakus and D. Kentric, 1981, A six-tier cake: an experiment with self-selected learning tasks ELT Journal 36, 1: 19-23

Littlewood, William, 1981, Communicative Language Teaching: An Introduction Cambridge, University Press

Mountford, Alan, 1976, The Notion of Simplification and its relevance to Materials Preparation for English for Science and Technology in Teaching English for Science and Technology Richards, J.C. (ed) Singapore, Singapore University Press

Nation, I.S.P., 1985, Testing Vocabulary Size Wellington, English Language Institute

O'Toole, Mitch, 1985, Language, Science and Secondary Schools New Settlers and Multicultural Education Issues 2, 1: 44-50

Robertson, Irene 1980 Language across the Curriculum: Four Case Studies London, Methuen

Saville-Troile, Muriel, 1984, What really matters in second language learning for academic achievement? TESOL Quarterly 18, 2: 199-219

Stubbs, M., 1976, Language, Schools and Classrooms London, Methuen

Stubbs, M., 1980, Language and Literacy: the Sociolinguistics of Reading and Writing Routledge

Taylor, C V., 1979, The English of High School Textbooks Canberra, Australian Government

Wells, Gordon, 1978, Talking with children: the complementary roles of parents and teachers English in Education 12, 2: 16-38

Widdowson, H.G., 1979, Explorations in Applied Linguistics Oxford. Oxford University Press See Ch.6 "Gradual Approximation"

Williams, Ray and Don Dallas, 1984, Aspects of Vocabulary in the readability of content area L2 educational textbooks: a case study in Reading in a Foreign Language Alderson, J.C. and A.H. Urquhart (eds) London, Longman

Wong-Fillmore, Lily, 1982, The Language Learner as an Individual: Implications of research on Individual Differences for the ESL teacher in On TESOL '82: Pacific Perspectives on Language Learning and Teaching M.A. Clarke and J. Handscombe (eds) Washington, TESOL

2 Teaching Materials

APEID "Pupil Evaluation in Science", UNESCO Regional Office for Education in Asia and the Pacific", Bangkok, 1985.

APEID "Training of Science Teachers' and Teacher Educators", UNESCO, Bangkok, 1985.

Cleland Bill and Evans Ruth, "Learning English Through General Science", Longman, 1984

Comfort, J-et al, 1982, Basic Technical English. (Oxford University Press)

Cooper, Jonelle, 1979, Think and Link. An advanced course in Reading and Writing Skills. London: Edward Arnold

Dalton, S and M O'Toole 1984, Science Exercises: Language Conscious Junior Science. Books 1, 2, 3. Richmond, Vic: Heinemann Educational Australia.

Donovan, P. 1978, Basic English for Science OUP.

Fletcher, Mark and Roger Hargreaves 1980, Defining and Verbalising London, Evans Bros. Skills for Learning 1980 Foundation 1980 Development. Surrey: Nelson/University of Malaya Press.

Kay, Valerie 1978, Biological Sciences: Developing Reading Skills in English (Oxford, Pergamo n).

New Zealand Science Teacher, No.46, August, 1985.

Royds & Irmak , E.E. 1975 Beginning Scientific English (Books 1 & 2) (Nelson)

Booklet 1:1

# SAMPLE UNIT

# ON

# KINAESTHETIC SENSES

Department of Education

Wellington 1986

SAMPLE UNIT

on

KINAESTHETIC SENSES illustrating how the communicative needs of the learners can be met.

CONTENTS

1 Original Worksheet

2 Vocabulary list and notes

3 Adapted and annotated worksheet on Kinaesthetic Senses

4 Teachers' notes

NOTE

This unit shows a sequence of classroom activities. Each activity is annotated with advice and information related to ESL learners. The numbers in brackets after each note refer to the relevant section of the teachers' notes at the end.

ORIGINAL STUDENT WORKSHEET

## OPTION 1 THE SENSE ORGANS

### EXPERIMENT 1 WHAT ARE KINAESTHETIC SENSES?

Kinaesthetic senses are senses that give us information about our position and balance. They help us to control movements accurately.

PART A One of your kinaesthetic senses helps you to do things with your eyes closed.

Try the following four activities with your eyes closed:

a Touch the tip of your nose with one finger
b Touch the lobe of your ear with one finger
c Touch your two thumbs together
d Touch the tip of your elbow with the tip of one finger.

Write down whether you had any difficulty with any of these.
Now REPEAT the above experiment with your eyes open.

Say whether you found any difference in the way you could do these activities.

PART B Sometimes your sense of balance can be upset by unusual movements. You may then get seasick or carsick. You may have noticed a funny feeling when travelling in a fast lift.

Try these five activities:

a Walk along a straight line with your eyes open.
b Stand on one foot for 30 seconds then on the other for 30 seconds.
c Repeat a. and b. with your eyes closed.
d Sit down and try and do these three thing quickly:
Hold your nose with your left hand and your left ear with your right hand; now place your hands on your knees; now hold your nose with your right hand and your right ear with your left hand. Repeat these actions as quickly as you can.

IN YOUR BOOKS: describe what happened in the activities above.

VOCABULARY FOR KINAESTHETIC SENSES

Essential words for this lesson

| | | |
|---|---|---|
| [5.2] | Kinaesthetic<br>sense<br>accurate - accurately | The lesson focusses on these words and both ESL and other learners will need some guidance in order to understand the meanings and to use the words correctly. |

---

Words possibly known in a different context

| | | |
|---|---|---|
| [5.1]<br>[5.2] | Balance<br>position | ESL learners (in particular) may not realise that these words are used differently from other contexts where they have met them before.<br>eg. a bank balance<br>What position do you play? |

---

Words ESL learners may not know

| | | | |
|---|---|---|---|
| | information | seasick | This list is a good area for co-operation with an ESL teacher. It may be possible in ESL classes to do intensive work on these words or set and check homework on them. It is likely that a science teacher with only one or two ESL learners in the class would have difficulty in finding time for this. |
| | control | carsick | |
| | movements | to diagram | |
| | sideways | actions | |
| | upside down | lobe | |
| | dive - diver | tip | |
| | example | thumb | |
| [5.3]<br>[5.4]<br>[GG5] | difficult<br>activity | elbow | |
| | way = direction | | |
| | may = possibility | | |
| | repeat | | |
| | upset | | |
| | unusual | | |
| | seconds | | |

Clear instructions [4.1] [4.5]

gives the students their own written record [GG1]

Nouns repeated instead of using 'they' [5.9]

Arrows help to give meaning to "turn ... sideways" "turn ... upside down" [GG1]

Addition of written version of material previously presented only orally [GG1]

Pupil Worksheet

You have studied the five senses.
Can you still name them?
Now we will study a different kind of sense.

Experiment 1

copy

## What are kinaesthetic senses?

Can anyone say this word?

copy

Kinaesthetic senses give us information about our position and balance.
Kinaesthetic senses help us to control our movements accurately.

Turn this page sideways.

Turn this page upside down.

Which way is the diver going in relation to the surface of the water?
How can you tell?

If you were the diver, which way would you swim to the surface?

Can you give another example where it is difficult to know our position in space?

Clear layout [4.2]- therefore more comprehensive input [GG1]

Box headings [4.5]

Some language focus [GG6]

Underline key words [4.6]

Use visuals [4.7]

One sentence per line [4.4]

Wide line spacings [4.3]

Part A

COPY ⇨ One of your kinaesthetic senses helps you to do things with your eyes closed.

Close your eyes.

Try the following 4 activities.

1 Touch the tip of your nose with one finger 3 times.
2 Touch the lobe of your ear with one finger 3 times.
3 Touch your 2 thumbs together 3 times.
4 Touch the tip of your elbow with the tip of one finger 3 times.

Were these activities easy?
Which ones were difficult?

COPY AND COMPLETE ⇨ I could touch _____ easily.

Keep your eyes open.
Repeat these activities – 1, 2, 3, 4.

WRITE ⇨ Write 2 lines about your results.

Repeated numbers make the input easier [GG1]

Direct questions [5.12]

A very simple writing task and a slightly more difficult one [GG7] [7.1]

Carefully sequenced instructions [GG1] [6.2] [6.3]

If they perform these actions correctly they have understood – a good listening exercise [GG3] [14.4]

A chance for students to discuss with each other [8.4] [8.5]

Careful separation of steps [6.2] and repetition [5.9]

## Part B

Sometimes your sense of balance can be upset by unusual movements.

COPY

You may then get sea-sick or car-sick.
You may have noticed a funny feeling when you travelled in a fast lift.

**Try the following 5 activities.**

1 Keep your eyes open.
Walk along a straight line.

2 Close your eyes.
Walk along a straight line in a different place.

COPY AND COMPLETE

When my eyes were open, _____
When my eyes were closed, _____

3 Keep your eyes open.
Stand on one foot for 30 seconds.
Hold the other foot behind you.

4 Now close your eyes.
Stand on one foot for 30 seconds.
Hold the other foot behind you.

5 Repeat 3 and 4 while you stand on the other foot.

These common words may not be known to ESL learners [5.3]

Clear indication of who performs actions [5.11]

Visuals and diagrams to add to verbal instructions [GG1] [6.1]

Clear instructions boxed to show particular action requir ed [4.5]

Structured writing task [7.1]

The same phrase is repeated [5.10]

Visuals and plenty of space improve readability [4.3] [4.7]

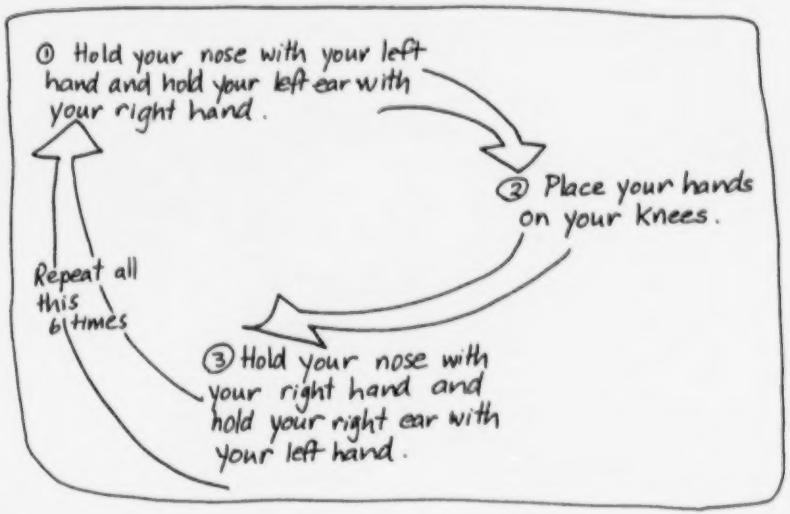
The instructions are very clear - if the ESL learners do the wrong thing this gives you valuable feedback on their level of comprehension [GG3] [1] [3]

IN YOUR BOOK → Diagram or Describe what happened to you in 4.

Choice of tasks [GG7] [7.2]

One for the A team

Sit down and do these 3 actions.
Do them very quickly.
You may practice once.


① Hold your nose with your left hand and hold your left ear with your right hand.
② Place your hands on your knees.
③ Hold your nose with your right hand and hold your right ear with your left hand.
Repeat all this 6 times

Sequencing and layout

A variety of tasks with extension work [7.2] [8.8]

A chance for group work and discussion [GG4] [8.4] [8.5]

IN YOUR BOOK → Describe what happened to you.

PROJECT → Can you design any other activity to test your kinaesthetic sense?

TEACHER'S NOTES ON WORKSHEET - KINAESTHETIC SENSES

We started with a science worksheet which is used in mixed ability classes in a multi-cultural school and altered the worksheet to take account of ESL learners. At the same time we considered how the altered worksheet would be used in a classroom and noted suggestions and observations, as they arose.

Three important principles behind most of the suggestions on adapting worksheets and using them are:

1 **Sequencing all classroom activity carefully** so that complex ideas or procedures are presented in conceptually simple and logically ordered steps. This naturally leads to less complex sentences.

2 **Being aware of communication through language** so that what is said or written is understood by those receiving it, and so there are frequent opportunities for feedback to check that learners understand.

3 **Having a range of appropriate demands on learners**, especially in writing activities, e.g. tasks ranging from very simple ones such as labelling diagrams to transferring information from a text to a table, through to free project work.

(See also the General Guidelines for Language Learning in Science Classes, GG1-8).

In the notes below, 4 - **LAYOUT** relates specifically to the setting out of worksheets. However, the comments under 5 - **LANGUAGE**, 6 - **INSTRUCTIONS**, 7 - **WRITING** and 8 - **ORGANISATION** apply as much to the teacher's way of talking to the class and arranging their work as they do to the preparation of worksheets.

4 - LAYOUT

4.1 Separate objectives, equipment and steps so that readers can identify them clearky.

4.2 Make general layout of worksheets as clear as possible.

4.3 Use wide line spacings.

4.4 Write one sentence per line.

4.5 Put directions and headings in boxes

4.6 Underline key words or use CAPITALS

4.7 Use visuals for interest, with some humour if possible.

## 5 - LANGUAGE

5.1 Discuss the vocabulary of the lesson to establish the meanings the students already hold.

5.2 Explain how the words will be used in the context of the lesson.

5.3 Remember there may be many words not known to ESL learners (see Vocabulary Sheets).

5.4 Science or ESL teachers may be able to use the Teacher's Vocabulary Sheet to prepare "Special Homework Sheets" on definitions and word use for ESL learners.

5.5 Use words which have a high frequency in a particular context, e.g. '<u>sore</u> muscles' instead of '<u>tired</u> muscles'.

5.6 Omit difficult, non-specialist vocabulary (e.g. suffer from, fatigue, proceeded) if it is not necessary, except ...

5.7 where academic or formal language is clear and frequently used; use it where appropriate, e.g. the number of, <u>not</u> how many ..., to identify, to record, a/to function.

5.8 Avoid verb + preposition pairs, e.g. take off -- remove, write down -- write, ring up -- telephone, look up -- find (in a reference book), go ) on -- continue.
Keep)

5.9 Repeat nouns used instead of substituting pronouns, e.g. <u>kinaesthetic senses</u> repeated instead of <u>they</u>.

5.10 Try to repeat the same words and phrases several times in the lesson instead of varying them, e.g.

| | | |
|---|---|---|
| far<br>as fast as possible<br>long | instead of | as far as possible<br>as fast as you can<br>as far as it will go |
| <u>hand movements</u><br>all the way through | instead of | stretching<br>stretches<br>movements<br>spreading etc. |

Frequent changes are confusing.

5.11 Try to make it clear who performs each action mentioned, e.g. you may have felt ... when you travelled in a fast lift.

5.12 Ask direct rather than indirect questions, e.g.

Were these results different?
instead of - Say whether you found any difference ...

## 6 - INSTRUCTIONS

6.1 Include diagrams to explain each step of the instructions.

6.2 Write instructions so that they contain only one idea or action. This makes directions absolutely clear,

e.g. 1 **Put your elbow on the table**

2 **Point your fingers to the ceiling.**

instead of

**Put your elbow on the table with your fingers pointing upwards.**

6.3 Put student directions in correct sequence

e.g. 1 **Boil the water**

2 **Add the egg.**

instead of

**Put the egg in when the water is boiled.**

6.4 A sequence of instructions is often very useful as a listening exercise. The visible evidence that the students have done the right thing shows that they have understood.

## 7 - WRITING

7.1 Give students structured options for writing reports, e.g.

- gap filling
- jumbled sentences
- sentence completion
- write a sentence under a series of diagrams
- a model sentence as a pattern for the students to write their own, e.g. At the _____ interval, the graph line dropped to _____.

7.2 Students at different levels need different writing tasks. Some students initially may only draw and label diagrams to show what happened in the experiment, while others may have structured exercises and advanced students will write their own accounts.

## 8 - ORGANISATION

8.1 Elicit examples from the class of the work being discussed, drawing on students' own personal experiences. Accept their contributions and relate them as far as possible to the topic.

8.2 Note that some experiences and activities may be foreign to ESL students and may need explanation, e.g. scuba diving, space travel, deciduous trees.

8.3 Reformulate other students' contributions in a clear, logical and simple way so that ESL learners can understand them.

8.4 Pair and small group discussion may be easier for ESL learners to follow and participate in than whole class discussion.

8.5 Allow students to talk to each other as much as possible about what they are doing.

8.6 Include a simple summary part way through explanations so the students can check whether they are on cue.

8.7 Remember you may have to go step by step on the blackboard through certain procedures (e.g. graphing) before students attempt to do it themselves.

8.8 Include an extension exercise for more able students (some ESL students may be in this category), e.g. PROJECT at the end of the worksheet.

Booklet 1:2

# SAMPLE UNIT

# ON

# MATTER

Department of Education

Wellington 1986

SAMPLE UNIT ON MATTER

Illustrating in particular how pre-testing is done

CONTENTS

1 Pretests

2 Introducing new learning

a The difference between matter and non-matter
b The difference between solids, gases and liquids

3 Applying and practising new information

4 Evaluation

5 Guidlines

6 Details of pre-testing

PREREQUISITE KNOWLEDGE

Pupils should be able to:

1 Classify and label

2 Differentiate between living and non-living things

e Give examples of things that exist although they cannot be seen.

OBJECTIVES

By the end of this unit students should be able to do the following things for matter and non-matter and for solids, liquids and gases:

1 Give examples and non-examples.

2 List at least two properties of each.

3 Classify common examples.

4 Talk about what they are doing.

5 Use both general and scientific vocabulary.

6 Use equipment

Level: Form 3

Note: This unit is based on a chemistry unit Matter prepared by Tony Trinick, Nga Tapuwae College, 1985. Copies of the original unit are available on request.

## Pre-tests

Three different kinds of pre-test are illustrated here. The first checks how well students can do things. The second checks their ability to work with knowledge expressed in words. The third shows a way to individualize and check a number of related skills and types of knowledge. Pre-tests can be the opportunity for new learning, for revision or for maintaining skills.

### Pretest One: Picture Sorting

The aim of the first pretest is to find out the pupils' ideas about matter, living and non-living things, about classification and to discover the language pupils use to express these ideas.

### Equipment

A selection of 15 pictures of matter, both living and non-living. The pictures should be selected from a cultural perspective and be labelled in English and any other appropriate language where possible.

### Activities

1 Sort pictures into groups, deciding on a label for each group and giving reasons for their groupings.

2 Sort pictures into living, non-living and not known.

3 Sort pictures into solids, liquids, gases and not known.

4 As an alternative to pictures, words can be sorted from a list into columns. For example:

| Gas | Solid | Liquid | Not known |
|---|---|---|---|
| | | | |

Pretest Two: Sentence Verification

The aim of the second pretest is to assess students' conceptual and linguistic knowledge of matter (rather than their performative skills).

Task

Tick the box with the correct information. (Do the first example together.)

1 ☐ Matter can be found at home.
☐ Matter is sometimes found at home.
☐ Matter is never found at home.

2 ☐ Matter can always be seen.
☐ Matter is sometimes seen.
☐ Matter can never be seen.

3 ☐ Matter can always be touched.
☐ Matter can sometimes be touched.
☐ Matter can never be touched.

4 ☐ Matter fills space.
☐ Matter sometimes fills space.
☐ Matter never fills space.

5 ☐ Matter can always be weighed.
☐ Matter can sometimes be weighed.
☐ Matter can never be weighed.

6 ☐ Matter is always coloured.
☐ Matter is sometimes coloured.
☐ Matter is never coloured.

7 ☐ Matter can always be smelt.
☐ Matter can sometimes be smelt.
☐ Matter can never be smelt.

Teachers take note of the students'

- Ability to read
- Ability to classify
- Ideas about solids, gases and liquids.

## Pretest Three: Science Checklist Cards

Ideally, there should be cards for each of the following items. Each card is designed to assess individual students' prior learning.

1 Familiarity with equipment

Match apparatus and labels
Match apparatus to functions
Find the old man out

2 Experimental technique

Label an experiment
Sequence an experiment
Draw conclusions from an experiment

3 Familiarity with common chemicals

4 Laboratory rules and emergency procedures

Tick the three most important items

5 Sight vocabulary

Vocabulary activities to check the understanding of, for example, aim, method, results, conclusion

6 Following instructions

7 General knowledge

Crosswords
Multiple choice answers
Picture identification

The appendix contains an example of a science checklist card focusing on techniques for experiments.

## Introducing the New Concepts

### The difference between matter and non-matter

1 Through class or group discussion, the teacher lists on the blackboard the properties of several pairs of objects, e.g.

| chair | sound |
|---|---|
| | |

other pairs

air/sunlight
water/book etc.

Introduce the word properties naturally into the discussion by reinforcing it with alternatives and repetition.

2 Carry out activities to show that gas can be weighed and takes up space, and any other activities that are needed to show some of the properties pupils are having difficulties with. Students may have suggestions here.

3 Through discussion, introduce the words matter and non-matter and label the groups arising from activity (1).

4 Reinforce the properties of matter by asking students to fill in the table with yes, no, don't know (or ✓, x and ?).

| | can be seen | coloured | can be touched | can be weighed | can be smelt | fills space |
|---|---|---|---|---|---|---|
| wood | yes | | | yes | | |
| air | no | | | | | |
| iron | | | | | | |
| oxygen | | no | | | | |
| sand | | | | | | yes |
| per-fume | | | | | yes | |

5 Pupils verbalize their own definitions of what is and isn't matter. Give the science definition if necessary.

5 Record the definitions in several different ways, including pictorially and in words.

6 Provide pupils with a variety of matter and non-matter words that would be unfamiliar, e.g. bauxite, ultraviolet. Pupils classify these into matter/non-matter groups by asking the teacher appropriate questions about its properties, e.g. Can you weigh it? They have to vary their questions.

Finding out the difference between solids, gases and liquids

1 Pupils and teacher list the properties of the following:

| water | air | a table |
|---|---|---|
| | | |

2 Pupils sort a number of objects into three groups:

| things like water | things like air | things like a table |
|---|---|---|
| | | |

These could be words on cards or pictures with labels or a combination of real things and pictures.

3 Pupils give their own labels for each group.

Give the scientific labels and match these with students' labels.

## Applying and Practising New Information

1 Solve problems

e.g. A cork lies in the bottom of a long, narrow container. It is too narrow to put a hand down. How do you get the cork out without tipping the container over?

2 Tasks

- Answering questions. Choose questions that require different levels of thinking.

  For example: What makes jelly like a solid or a liquid?

- Rank items. Supply a list of things and ask pupils to rank them as to which are most like solids. Agree on only the first two and the last.

  For example: concrete, putty, sunlight, lino, marshmallow, jelly

- Complete a table.

  For example: See section (4), page 5

- Interact with other people in pairs or groups. Use interview cards.

- Do experiments. (See textbooks.)

- Investigate, choosing things from everyday life and vocations.

- Do vocabulary exercises.

  a Put a circle around the words you could use instead of the words on the left.

  Matter: stuff, light, substance, material
  Space : area, volume, colour, room

  b Make up sentences using the following cards. Write down the sentences.

| | | | |
|---|---|---|---|
| solids | | | |
| matter | | | |
| gases | fill(s) | room | and can be weighed |
| substances | take(s) up | volume | |
| liquids | | space | |
| material | | | |

c Fill in the gaps with <u>is</u> or <u>is not</u>.

e.g. A table _____ matter.

A dog _____ matter.

LPG ___ matter.

Noise ____ matter.

d Do crosswords or unjumble words.

e Play 'Who am I?' Pupils choose an example of matter or non-matter.

## Evaluation

Repeat activities used in previous seftions, (such as in section C2 or C3,) but substitute some new items.

# GUIDELINES FOR WORKING WITH SECOND LANGUAGE LEARNERS IN SCIENCE

Principles of learning apply to all students. However, details in the application of the principles may differ when students are also learning the language of instruction, in this case English, at the same time.

## Pretesting

1 Often the first activities in a unit can give teachers information about students' previous learning and experiences.

2 Initial activities should not rely on advanced language proficiency. Some pretesting can be done through:

- Sorting pictures and objects
- Checklists using pictures
- Tables requiring simple responses
- Students underlining words they do not know.

3 It is not always clear whether the difficulty a student has is with the language or with the concept. Activities that involve pictures and their labels get around this problem.

4 The experiences of students coming from other schools are so diverse that a means of checking these previous experiences is helpful. One idea is to have a science box containing cards that can be the basis of a number of checking activities.

## Introducing New Learning

1 It is important for students to see the important words repeatedly. For example, the word 'matter' should be repeated instead of using 'it'.

2 Where students have difficulty knowing what to do, work through an example with them.

3 In teaching a new idea make sure you have both examples and non-examples of the new concept.

4 When students are classifying new ideas, make sure you have a 'don't know' column, so that students can feel comfortable about what they don't know. This technique also avoids questions about what to do.

5 Start with the language students' use and the ideas they have. Gradually introduce new science terms and new examples. Keep relating the science terms to examples the students are familiar with.

6 Student talk about new learning is an important part of acquiring it. Writing can also help to clarify ideas too, provided the students are processing what they write.

7 Asking questions is both a science and a language skill. There can also be cultural reasons why students prefer not to ask questions. Group work and using people as resources help overcome such difficulties.

8 Don't underestimate the number of examples and the amount of talking opportunities needed at the beginning stages of new learning.

## Applying and Practising Information

1 When possible, practice activities should cover both real life tasks and the kind of tasks that people do in different occupations. Introduce students to the kind of work done in a range of occupations and life styles.

2 Ideally, some of the best learning occurs when people are talking to one another and when they are totally involved in getting a job done. There are many constraints working against this principle, but at the same time an increasing number of teachers are trying to promote talking about science.

3 Throughout the unit there should be a number of supplementary versions of material at different levels of readability. Some of these should, if possible, be in the first language that the students speak.

## Evaluation

1 To evaluate a unit, use similar tasks to those earlier in the unit. Have some items familiar to the students and some new.

2 Evaluation activities can also act as pretesting for the next unit.

3 When students make incorrect responses it may be due to using the everyday meaning of words instead of their scientific meaning.

## DETAILS OF PRETESTING

Prior learning and experiences, whether of the subject or of the language, determine which activities are helpful during the unit. Some of this information can be used for all subjects and could be collected during the year. Other information is specific to one subject in the curriculum or even one topic within that subject.

In particular it needs to be noted that some students will have the concepts without the English to express the concepts, while others may recognize the words without properly understanding the ideas.

The table on the following page summarizes some principles for pretesting the science understanding and the English proficiency of second language learners.

## PRE TESTING

| The teacher needs the following information | This information is needed in order to determine: | How can pretesting be done? |
|---|---|---|
| **Vocabulary levels** | | |
| a Does the student have an understanding of the 2000 most common words in general English? | 1 Level of texts and worksheets.<br>2 Level of teacher language.<br>3 Vocabulary learning tasks to be set in science.<br>4 Expectations for students' book work. | 1 Label Pictures.<br>2 Underline unknown words.<br>3 Multi-choice items based on short context.<br>4 Match words and definitions.<br>5 Cloze exercises.*<br>6 Sentence completion.<br>7 Use words in sentences. |
| b Does the student have an understanding of the 1000 most common words in academic English? | | |
| **Reading** | | |
| a What kind of reading material can a student easily understand? | 1 Reading resources, tasks and approaches.<br>2 Level of worksheets.<br>3 Science teacher's potential role in the student's reading development. | 1 Underline unknown words.<br>2 Keep oral reading records.<br>3 Use cloze techniques.<br>4 Design multi-choice comprehension questions.<br>5 Use PAT results. |
| b What is the next step in a student's reading development? | | |
| **Prior learning** | | |
| In relation to the new unit, what is the quality of the student's<br>- knowledge<br>- concepts<br>- skills<br>- experiences? | What can be achieved in a new unit : the likely benefits and difficulties that previous experiences will bring. | 1 Picture and diagram interpretation tasks.<br>2 Performance tasks<br>a Identification tasks<br>b Classification tasks<br>c Problem solving tasks.<br>3 Concept feature tasks.<br>4 Interview or checklist cards that can make use of the student's first language<br>5 Free writing or talking where students list what they know.<br>6 Teacher-made tests (multiple choice, short answer, cloze....)<br>7 Informal question[illegible]re. |

- 12 -

40

41

* Ask an ESL teacher for a definition

APPENDIX

## Science Checklist Card [1]

### Observe

An observation is something you:

* see
* hear
* feel
* taste
* smell

An example

Observing

Look at a biscuit

* Can you see the shape?
* Can you feel the biscuit?
* Can you hear the biscuit break?
* Can you smell the biscuit?
* Can you taste the biscuit?

Warning

Do not taste things in the science classroom unless the teacher tells you.

### Record

A record is written in your books.

You can write or draw what you:

* see
* hear
* feel
* taste
* smell

An example

* The biscuit was round and thin
* It was smooth.
* I broke it. It made a snap sound.
* It smelt like chocolate.
* It tasted sweet.

Hint

A large, neat diagram with good labels saves a lot of writing.

a round _____
thin
I heard a____
when I broke the biscuit.
Weight _____ grams



[1] Adapted from J Slater, I D Walsh, T G Woolley Prerequisite Laboratory Skills Longman, 1985, p.68.

Booklet 1:3

# SAMPLE UNIT

# ON

# ELECTRICITY

Department of Education

Wellington 1986

SAMPLE UNIT

on

ELECTRICITY illustrating how the communicative needs of the learners can be met

CONTENTS

1 Simple Circuits

2 Symbols

3 Circuit Diagram

4 Model of Electron Flow

OBJECTIVES

By the end of this unit students should be able to::

1 Construct a simple electrical circuit containing battery (cell), light bulb, wires.

2 Represent the circuit using a circuit diagram and label the parts.

3 Distinguish between open (incomplete) and closed circuits.

4 Express the concept of electron flow as a simple model

5 Communicate the ideas in this unit by explaining orally or in written form how a simple circuit works.

Note

This unit shows a sequence of classroom activities for the topic of electricity. Each activity is annotated with advice and information related to ESL learners. The numbers in brackets after each note refer to the relevant section of the Points to Consider at the end of the unit.

1

Say the instruction.
Write it down.
Demonstrate it. (2.1)

Take the equipment
Try to make it go
Talk about what you are doing

Draw and label the equipment
in your notebook.

Some students will find it easier to discuss the ideas initially in their own language. (2.3)

For many new language learners the problem is to get an overview of the topic at the beginning of the lesson. Having actual materials from life is one way of overcoming this. (3.1)

Unless students have a record to refer to later, the content of a lesson, however exciting, cannot be recalled later. (3.4)

Look at an example of complex wiring (photo of aeroplane, house, car wiring).

Suggest why it would be difficult to draw.

Look at 5 symbols

Guess the names

Copy the named symbols correctly into notebook.



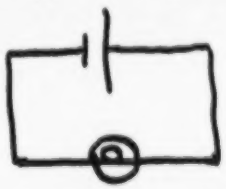
Remember that the ESL learner may need more time to put the answer in words, even if the answer is known. Try one of these: (2.8)

- put questions to individuals while the rest of the class is working
- invite students to write answers down
- ask the students to discuss the answers in pairs. (2.5)

4

Look at this picture of a circuit diagram.

Identify the parts



Compare this with the circuit made at the start of the lesson.

Copy the labelled diagram into notebook.

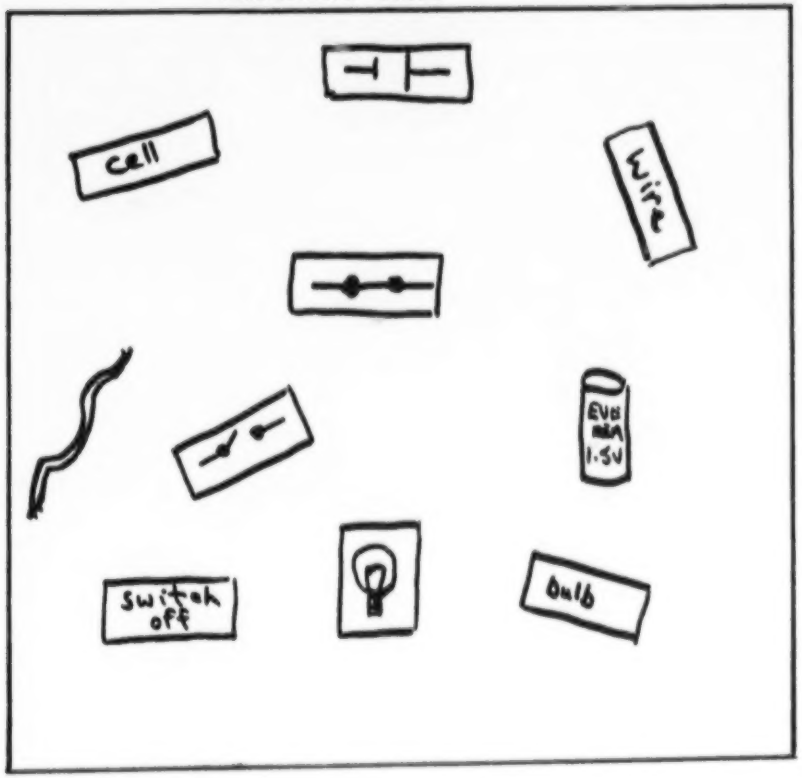
Look at the example of complex wiring.

Try to find the symbols that have been used in the lesson.



Choose an example that is likely to be familiar to students from differing cultural backgrounds. (1.1)

MATCHING GAME




This game can be used for ESL learners in a separate group. It can be expanded to use more symbols and by using more complicated rules.



Make sets of cards with names, diagrams and symbols and use in a matching game with real objectives.

Encourage student talk by dividing objects and cards amongst members of group who then need to communicate in order to match.

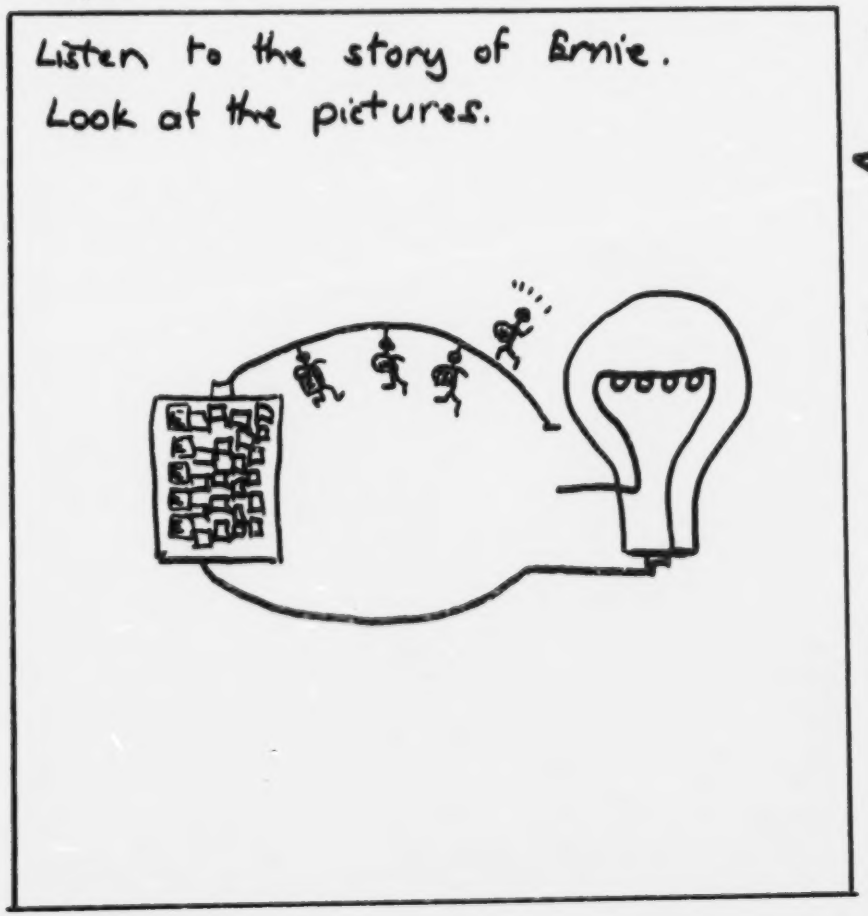
Some ESL learners will not have associated names with objects. Matching allows them to bring the names and objects together and also learn the symbols. (3.5)

Allow learners of English to work with able science students so that the language and concept learning go hand in hand. (2.5)

'Battery' is used here instead of the scientific term 'cell' because battery is more likely to be heard outside the classroom. The word 'cell' could be introduced when considered appropriate.

6

A narrative sequence is a tangible way of introducing an abstract topic.




Choose names that reflect the nationalities in your class. (1.2)

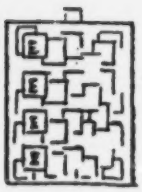
See appendix.

Invite students to give names for the new items in their own language. (1.5)

The new language is introduced as the teacher explains the concepts. Students are looking as well as listening. (2.4)

# THE STORY OF ERNIE ELECTRON

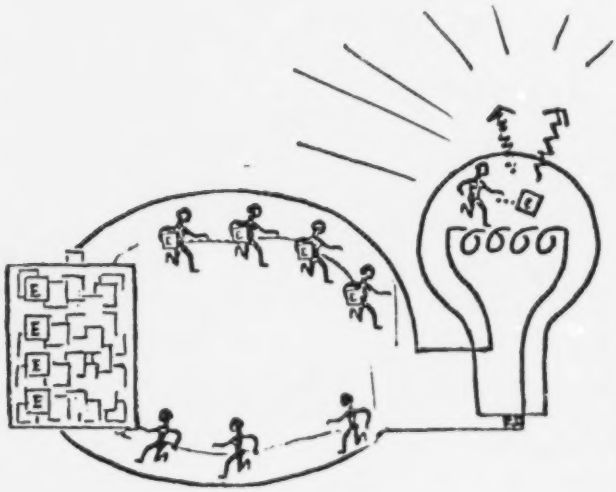
1



## The Battery

A battery/cell is a store of energy. This is represented as "boxes" of energy.

2

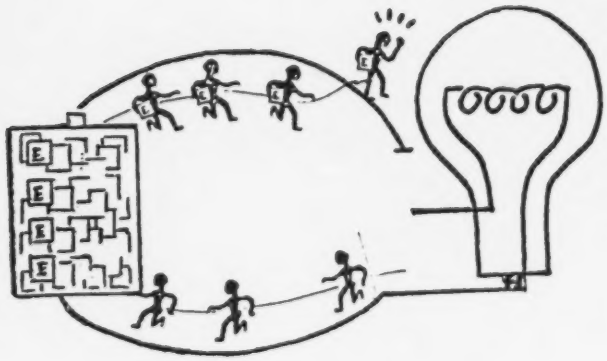


## The Closed Circuit

Ernie Electron belongs to a team of "runners" who pass along the wires. They are all roped together. If one stops - they all stop. As Ernie passes through the light bulb filament, he finds it difficult to run through the loops so he throws away his load of energy. This energy "becomes" heat and light energy.

Ernie then runs back to the battery to pick up another box of energy.

3



## The Open/Broken Circuit

The path is broken - Ernie can't get past.

Because the runners are all roped together they <u>all</u> stop so no "current flows.

<u>NB</u> : This is the bones of the story, and teachers will modify language in the telling of it. While not "scientifically accurate" it helps in putting across a very abstract concept.

CIRCUITS AND SYMBOLS
CHECK-TEST

NAME _____

Look at each diagram and work out if the bulb will light up

Will this bulb glow? _____

Will this bulb glow? _____

Will this bulb glow? _____

Will this bulb glow? _____

Will this bulb glow? _____

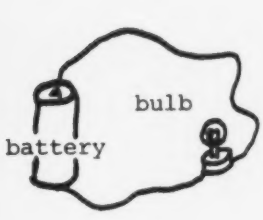
Will this bulb glow? _____

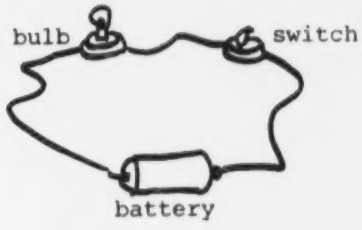
Your rating

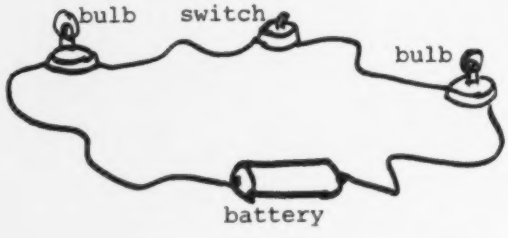
CIRCUITS AND SYMBOLS
CHECK TEST

NAME _____

Use the correct SYMBOLS to draw diagrams of these 3 circuits.






YOUR RATING

Notes to Science Teachers

1 When drawing "Ernie Electron" diagrams keep in mind the direction of movement. (Actual or conventional current?)

2 Diagrams should represent actual apparatus being used. There can be difficulties if torch batteries are drawn in diagrams of explanation but telephone batteries are actually issued.

3 This unit does not lend itself easily to pretesting. The practical nature of the activities reveals the prior knowledge and experience of the student. Evaluation exercises are included in the form of check-tests.

## Points to Consider

Science teachers can attend to cultural and language aspects of learning as well as considering general teaching techniques if they have students from a number of ethnic origins in their classes.

The following list is a summary of the points made in the sample lessons.

1 Cultural Suggestions

Previous Experiences

1.1 Choose examples that draw on the students' previous experiences, eg movie cinemas powered by generators on DC Current, christmas tree decorations.

Crosscultural Examples

1.2 Use names from many languages eg Ernie, Eseta.

Previous Learning

1.3 Be aware of versions the students may already be familiar with through mythology. Most countries have stories about, for example, the creation of light, where natural phenomena are explained through metaphors.

Learning Style

1.4 Some students come from school systems where questions to the teacher are not part of the learning process. Therefore the teacher may have to check understanding in other ways.

Other Languages

1.5 Introduce terms from other languages as a means of recognising the students' previous learning.

2 Language Suggestions

Teacher Language

2.1 Give instructions in several ways:

say them
write them down
demonstrate them
show diagrams

Some learners can read English better than they can listen or vice versa.

Teacher Language

2.2 Repeat nouns, rather than use pronouns. For new language learners it is hard to recall what 'it, these' stand for.

Other Languages

2.3 Encourage new learners to discuss ideas in their first language.

Learning English terms will happen better once the ideas have been understood than if new ideas and new words are being learned together.

New Language

2.4 Associate new words with the actions and objects they stand for by talking as much as possible during demonstrations.

2.5 Pair new learners of English with able science students who can talk about what they are doing.

2.6 Provide glossaries of important terms.

2.7 Provide models of the writing tasks set. Science teachers also need to be aware of the following language points.

Levels of Language

a Some scientific words have simpler words which students may already know (cell, battery).

b Some scientific words have different meanings or associations in common language:

(open circuit - does not work),
closed circuit - does work).

c The way we say things and the way we write the same thing are often different.

(Fill in this table,
Complete this table).

2.8 Give the learner time to formulate responses. Often an answer is known but the learner finds it difficult to express it. The searching for expression is crucial and needs time.

## 3 Learning Suggestions

### Starting the Lesson

3.1 Often a student who is learning English cannot "see the wood for the trees". Think of ways of starting the lesson that allow the student to start understanding immediately, eg

NOT "Today we are learning about circuits"

BUT "Look at (something)

3.2 Move from concrete examples to figurative diagrams. Object ----- diagram.

3.3 Application

Apply the new learning to real life examples.

3.4 Summary

Summarise new learning in ways the students can refer to later.

- tables
- handouts
- summary sentence

3.5 Checking

Check understanding in ways that do not depend too heavily on a knowledge of English.

- yes/no checklist
- table to complete
- grouping, labelling

3.6 Levels of Difficulty

Provide activities at different levels of difficulty.